Adult and Juvenile Coho Salmon Enumeration and Coded-wire Tag Recovery Analysis for Zolzap Creek, BC, 2000

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ADULT AND JUVENILE COHO SALMON ENUMERATION AND CODED-WIRE TAG RECOVERY ANALYSIS FOR ZOLZAP CREEK, BC, 2000

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ABSTRACT

Baxter, B.E. and C.Y. Stephens. 2002. Adult and juvenile coho salmon enumeration and coded-wire tag recovery analysis for Zolzap Creek, BC, 2000. Can. Manusc. Rep. Fish. Aquat. Sci. 2598: viii + 46 p.

Adult and juvenile coho migrations were monitored at Zolzap Creek, British Columbia, as part of the 2000-2001 Nisga'a Fisheries Program. The 2000 season is the ninth year of continuous operation of the Zolzap Creek fences since 1992. This report includes nine year summaries of the most pertinent data. Smolt trapping was conducted from April 28 to June 17, 2000 using an in-stream wire-mesh fence. A total of 33,934 coho smolts were captured during the trapping period, and an unknown number migrated out during periods when the fence was not operational. Of those captured, 30,132 were released with coded-wire tags. Migration timing, mean length and weight at age, and age composition are presented.

Adult coho escapement was monitored using an in-stream fence and carcass surveys. The counting fence was operational between August 22 and November 15. A total of 412 adult coho were counted at the fence with an estimated escapement of 456 using the adjusted Peterson model. Adipose-clip rate was 63.6% for adult coho. Age and length characteristics of adult males and females are presented.

Canadian and US commercial harvests were examined using coded-wire tag recovery data obtained from the Mark-Recovery Program and the Alaska Department of Fish and Game (ADF&G) mark tag and age lab online searchable database. Total exploitation rate on Zolzap Creek coho in 2000 was 52.0% (11.1% Canadian, 40.9% US). Of the total commercial catch of Zolzap Creek coho, Canadian catch accounted for 0.0% and the US catch accounted for an estimated 100%. Harvests occurred over a wide area ranging from S.E. Alaska to the US Northern Outside Statistical Area in Alaska (northwest of Juneau, AK). Due to concerns over declining coho stocks the Canadian fishery was shut down for coho harvests this year. A total of 1 sport fish recovery was received in Areas 1-5 of the Canadian fisheries for Zolzap Creek in 2000. US harvests of Zolzap coho in Alaska were largest in the Southern Inside Statistical Area for the net fishery and the Central Outside Statistical Area for the troll fishery. Total survival was 4.3% and smolt-to-spawner survival was 2.0%.

RÉSUMÉ

Baxter, B.E. and C.Y. Stephens. 2002. Adult and juvenile coho salmon enumeration and coded-wire tag recovery analysis for Zolzap Creek, BC, 2000. Can. Manusc. Rep. Fish. Aquat. Sci. 2598: viii + 46 p.

Les migrations de saumons coho, adultes et jeunes, ont été mesurées au ruisseau Zolzap en colombie-britannique, dans le cadre du programme des pêcheries des Nisga's en 2000-2001. La saison 2000 marque la neuvième année d'opération continue des barrières du ruisseau Zolzap depuis 1992. Ce rapport contient les sommaires des données les plus intéressantes pour les 9 dernières années. Le piégeage des saumoneaux prit place entre le 28 avril et le 17 juin 2000 à l'aide d'une barrière en fil métallique installée dans le ruisseau. En tout 33,934 saumoneaux coho furent capturés pendant la période de piégeage tandis qu'un nombre inconnu a migré quand la barrière n'était pas opérationelle. Sur l'ensemble des saumoneaux capturés, 30,132 ont été remis à l'eau avec une marque magnétique codée. Nous présentons la période de migration, la longueur et le poids moyens selon l'âge ainsi que les groupes selon l'âge.

La remonte de saumons coho adultes a été surveillée grâce à une barrière installée dans le ruisseau et à l'observation des carcasses. La barrière de comptage fut opérationelle entre le 22 août et le 15 novembre. Un total de 412 saumons coho adultes ont été dénombrés à la barrière avec une migration estimée à 456 en utilisant le modèle rajusté Peterson. Le taux d'ablation de la nageoire adipeuse était de 63.6% pour les saumons coho adultes. Nous présentons les caractéristiques d'âge et de longueur pour les males et les femelles adultes.

Les récoltes commerciales canadiennes et américaines ont été examinées grâce aux données de récupération des marques magnétiques codées provenant du programme de marquage-récupération et en directe de la base de données du département de Pêche et Chasse de l'Alaska. En 2000 le taux total d'exploitation du saumon coho au ruisseau Zolzap fut évalué à 52.0% (11.1% pour le Canada, 40.9% pour les Etats-Unis.) Sur le total de prises commerciales de saumon coho au ruisseau Zolzap, le Canada en comptait 0.0% et les Etats-Unis, une estimation de 100%. Les récoltes couvraient un vaste secteur, s'étendant à partir du sud-est de l'Alaska jusqu'à la zone statistique nord extérieure de l'Alaska (au nord-ouest de Juneau AK). A cause de soucis concernant le déclin des stocks de coho, pour cette année une fermeture fut imposée sur la pêche canadienne. Dans la pêche récréative canadienne pour le ruisseau Zolzap en 2000 seulement un poisson de sport fut récupéré dans les zones 1 à 5. La récolte par les Etats-Unis en Alaska des saumons coho du Zolzap fut plus nombreuse dans la zone statistique sud intérieure pour la pêche au filet, et, dans la zone statistique centrale extérieure pour la pêche à la traine. Le taux total de survie fut 4.3% tandis que pour les saumoneaux/géniteurs le taux de survie fut 2.0%.

INTRODUCTION

As part of the Aboriginal Fisheries Strategy (AFS) a program was established for fisheries research in the Nisga'a Traditional Territory, British Columbia. One component of this large research initiative focused on the assessment of juvenile and adult coho populations in tributaries to the Nass River. Juvenile and adult coho enumeration studies have been conducted on Zolzap Creek since 1992 (Nass 1996a; Nass 1996b; Nass and English 1994; Nass 1996c; Nass 1997a; Nass 1997b; Nass 2001; Nass and Frith 2001; Baxter et al. 2001; Baxter and Stephens 2002). This report presents results for studies conducted at Zolzap Creek in 2000.

The objectives of the research were to:

1. Enumerate migrating juvenile coho and estimate escapement;
2. Document the timing, size, and age distribution of migrating coho;
3. Mark coho smolts with coded-wire tags (CWT) to enable the determination of oceanic harvest rates;
4. Monitor the escapement for marked CWT adult coho, and determine ocean exploitation and survival rates; and
5. Collect water temperature and level data for future examination of the relationships between physical environmental factors and coho smolt migration timing, and between adult escapement and smolt production.

Achievement of these objectives involved the construction and operation of in-stream, semi-permanent, panel fences located approximately 0.5 km upstream of the mouth of Zolzap Creek.

STUDY STREAM

Zolzap Creek is a tributary to the Nass River, located in northwestern British Columbia (Figs. 1 and 2). Zolzap Creek flows for 6 km in a northwesterly direction between Nisga'a Lava Bed Memorial Park and the Kitimat Mountain Range to its confluence with the Nass River, 5 km downstream of Gitwinksihlkw. The main channel of the creek is regularly interrupted by beaver dams and log jams. The substrate is highly variable and ranges between silty particulate, to granite cobble, and coarse pumice. Major flow contributions come from Lava Creek (3 km in length) which flows from the lava beds and numerous small creeks that flow from the steep alpine. Intermittent flows of water from the Nass River and Vedder Creek are possible during flooding periods. The mouth of Zolzap Creek enters a side channel to the Nass River known as Zolzap Slough. The lower 0.5 km of Zolzap Creek regularly becomes inundated when water levels on the Nass River are high. Zolzap Creek supports many species of salmonids including coho (*Oncorhynchus kisutch*), pink (*O. gorbuscha*), chum (*O. keta*), sockeye (*O. nerka*), rainbow (*O. mykiss*), cutthroat (*O. clarki*), and Dolly Varden (*Salvelinus malma*). Non-coho species include lampreys (family Petromyzontidae), sticklebacks (family Gasterosteidae), and sculpins

(family Cottidae). Coho escapement was estimated to be 1,561 in 1992 (Nass 1996b), 1,048 in 1993 (Nass 1996c), 2,536 in 1994 (Nass 1997a), 908 in 1995 (Nass 1997b), 1,039 in 1996 (Nass 2001), 470 in 1997 (Nass and Frith 2001), 967 in 1998 (Baxter et al. 2001), and 1,393 in 1999 (Baxter and Stephens In Prep).

JUVENILE COHO STUDIES

METHODS

Trapping Operations

An in-stream, semi-permanent enumeration fence was located 0.5 km upstream of the creek mouth for the capture of downstream migrating coho smolts. Fence design was based on Conlin and Tutty (1979) and minor modifications were required due to site characteristics and available materials. The fence was built in a W-pattern and spanned the entire creek bed. Three by eight foot panels constructed of 2"x 4"s and covered with ¼" wire-mesh were laid on their long side in the creek bed to form the fence. Rebar of ¾" and ½" diameter were used to anchor the panels to the stream bed. A second layer of panels were installed on top of the first row of panels to create a fence with a total height of six feet. Burlap sandbags and heavy duty plastic garden sheeting were used to seal the base of the panels. Two hinged panels were installed in each of the fence wings for release of excess water in the event of flooding. Plywood trap boxes with Vexar-screened windows (to allow water exchange) were anchored at each down-stream apex and were connected to the fence with 8" Big-O tubing. Additional boxes were made for holding fish after processing and were designed with a small door for releasing fish. Provisions for upstream migrating adults were made by constructing a simple trap consisting of a wire-mesh panel extending out from the stream bank to one wing of the fence. Plywood was used to cover the adult trap area.

Physical Observations

Crews monitored water temperatures, water levels, and weather daily. Crews recorded temperature to the nearest degree (1 °C) using a maximum-minimum thermometer and water level using staff gauges calibrated to the nearest centimeter (0.01 m). A total of three staff gauges were used; two were located within 50 m of the trapping site (one upstream, one downstream of the fence) and one approximately one kilometre upstream of the fence. Precipitation was recorded on a scale of zero to five with zero representing no precipitation and five being heavy precipitation.

Fish Enumerations

Daily numbers of coho smolts captured at the fence were obtained from automatic counters on coded-wire tagging machines or by manual counts. The number of fence mortalities was added to the total count. Coho juveniles with standard lengths greater than or equal to 70 mm were identified as smolts. Coho smaller than 70 mm tended to be dark with distinct parr

marks and lacked the silver colouration typical of smolts. Therefore, this group consisted of pre-smolts and fry. All coho pre-smolts and fry, and non-coho species were counted and released downstream of the fence during sorting. Upstream migrating juveniles caught in the adult traps were counted and released upstream.

Biosampling

A random sample of up to 25 smolts (i.e., coho greater than or equal to 70 mm) were obtained from each day's catch. These smolts were anaesthetized and measured for fork length and weighed using an electronic scale (0.1 g). Scale sampling followed the stratified method of Ketchen, described by Ricker (1975); age sample data (column X on Table 1) included non-random samples, and length sample data (column Y on Table 1) and the calculated age representation was based on random sampling. Crews attempted to collect at least 10 scale samples from each 5 mm size class of coho for the study period. Smolts from under-represented size classes were selected to supplement random samples. Mean length and weight data was determined by multiplying the mean length and weight data for each 5 mm bin class by the total number of length and weight samples in that bin class (factor) to come up with a weighted mean length and weight for that bin class. The average length and weight for all sampled fish was determined by summing all the weighted length and weight measurements and dividing by the overall sum of the factors. Scale samples were interpreted by the Fisheries and Oceans Canada Scale Lab, Nanaimo, BC. Secondary quality control checks were performed to ensure a reliable age designation. Scale ages are reported in Gilbert-Rich notation where freshwater age-2 coho (i.e., having survived two winters from egg deposition) have a single freshwater annulus.

Biosampling was also conducted on a sub-sample of cutthroat, steelhead trout and Dolly Varden. In addition, DNA samples (caudal-fin clips in ethanol) were obtained from adult and juvenile cutthroat and submitted to Ministry of Environment Lands and Parks (Dana Atagi, Smithers, BC) for analysis. No data or analysis are presented here, but the data can be obtained from the principal author.

Coded-wire Tagging

Coded-wire tagging at Zolzap Creek was performed using a Mark IV tagging machine (Northwest Marine Technology Ltd. Shaw Island, WA). Smolts were anaesthetized in a MS222 bath prior to tagging. All tagged fish were adipose-fin clipped (AFC). The numbers of coho smolts tagged with each tag code and the number of smolts untagged were recorded. All tagged smolts were placed in a holding box in the stream and allowed to recover from the tagging operation before release.

Tag retention tests were conducted for each tag code. A sample of tagged coho smolts (minimum of 200 smolts) were retained in a holding box from 24 h to 96 h. Following the holding period, smolts were lightly anaesthetized and checked for the presence of a coded-wire tag using the quality control device (QCD) from the coded-wire tagging machine. Coho smolts not possessing a tag were checked a second time. The total number of tags detected for each tag group and the total number of fish tested was recorded.

RESULTS

Physical Observations

Water temperatures during the smolt migration period at Zolzap Creek ranged from a minimum of 4 °C in late April to a maximum of 8 °C in mid-June (Fig. 3A). Water level at gauge 2 (50 m upstream of the fence) remained steady at a gauge height of approximately 0.3 m from the beginning of monitoring on 28 April until 31 May. Water level rose steadily to a level of 0.7 m on 6 June and then rose rapidly to 1.3 m within a 24 hour period, flooding the fence. Water levels subsided within 24 h and remained steady at a staff gauge height of approximately 0.9 m until the end of the spring monitoring period. High water levels in Zolzap Creek occur when the Nass mainstem flow rises causing water to back-up into the creek. Water flow in Zolzap Creek declines to very low velocities during these flooding events.

Fish Enumerations

The Zolzap Creek juvenile counting fence was operated from 28 April to 17 June 2000. The fence was topped for a 24 hour period on the 7 June and then operated without any further interruptions until the end of the spring monitoring period.

Coho Smolts: A total of 33,934 coho smolts were counted at the fence (Table 2). The maximum daily number of smolts captured at the fence was 2,813 and occurred on 22 May (Table A-1, Fig. 4). An unknown number of smolts moved past the trapping location during the 24 hour period that the fence was flooded. An additional 500 smolts were estimated to have left the system based on the pattern of migration. There were a total of 81 fry and pre-smolt coho counted and released during trapping operations and 7 mortalities (Table A-1).

Non-coho Species: Juvenile Dolly Varden were caught in the largest numbers followed by lampreys (larvae and young adults), juvenile cutthroat, and juvenile sockeye (Table 3, Table B-1).

Biosampling: Length, Weight, and Age

The mean fork length of age-2 smolts was 104.6 mm and the mean weight was 11.4 g (Table 1). Age-3 smolts averaged 121.8 mm and 17.9 g. The length-frequency distribution showed substantial overlap between age-2 and age-3 coho (Fig. 5). Age-2 smolts were most numerous in the 95 - 100 mm length class and age-3 smolts were most numerous in the 120 - 125 mm length class. Age-3 coho smolts were significantly larger than age-2 smolts (t-test, $p < 0.05$). Overall, coho smolts averaged 105.3 mm in length. The calculated freshwater age structure of coho smolts was 95.5% age-2 and 4.5% age-3 (Table 1).

Coded-wire Tagging

Mean tag retention was 99.7% for tag code 28-01-04, 98.1% for tag code 28-01-05, and 99.8% for tag code 28-16-19 (Table 4). Crews conducted eleven tests for tag code 28-01-04 for a total of 2,200 samples with six tag losses, eight tests for tag code 28-01-05 for a total of 1,600 samples and a total of 30 tag losses, and five tests for tag code 28-16-19 for a total of 1,000 samples with 2 tag losses.

Releases of adipose-fin clipped coho totalled 30,304 (Table 5; Table C-1). Crews recorded 121 mortalities associated with the tagging process. The total number of coho smolts released with coded-wire tags was 30,132. Approximately 9.6% (3,212) of the captured coho smolts were released untagged during the study period and thus the mark rate of coho smolts released was 1.11 (Table 5). The total number of smolts released was 33,516.

ADULT COHO STUDIES

METHODS

Population Estimates

An aluminum conduit fence anchored to a crib-type sill was constructed at Zolzap Creek. All salmonids caught at the fence were counted and classified by sex. Sex was distinguished on the basis of length and body morphology. Previous studies at Zolzap Creek (Nass 1996b, 1996c, 1997a, 1997b, Nass 2001, Nass and Frith 2001, Baxter et al. 2001, Baxter and Stephens 2002) have shown an absence of jacks in the escapement, and therefore all males were classified as adults. "Jack panels" consisting of 1" wire mesh were used to prevent the passage of small coho through the fence and were used whenever water levels and debris permitted. Each coho was tagged on the operculum with a uniquely numbered Ketchum kurl-lock tag and measured for length. During handling, fish were examined for fin clips or tags that would be associated with coded-wire tagging or mark-recapture studies taking place on the Nass River. All captured fish were released upstream of the fence.

Adult coho abundance downstream of the fence was assessed later in the migration period due to the lack of fish movement past the fence. Delayed migration was the result of persistent low water conditions in Zolzap Creek in the later fall period. During these periods of delayed fish movement, angling was conducted approximately 1 km downstream of the fence in Zolzap Slough to determine relative coho abundance. Coho were examined for sex and AFC's, and a uniquely numbered opercular tag was applied. All fish captured were released back into Zolzap Slough. Live coho were recaptured in upstream surveys and checked for operculum tags. Carcasses were recovered on the fence and during upstream surveys. In 2000, carcasses were recovered primarily in the lower 5 km of the creek.

Biosampling

All live coho captured at the fence were measured for postorbital-hypural length and examined for fin clips and sex. Data recorded from coho captured at the fence were used to calculate sex ratios and mean length by sex. Crews attempted to sample at least 25 coho a day for scales (5 scales per fish). Scale samples were sent to the Fisheries and Oceans Canada scale lab, Nanaimo, BC for age determination. Secondary quality control checks were performed at the scale lab to ensure reliability of the age designations. Scale ages are reported in Gilbert-Rich notation where freshwater age-2 coho (i.e., having survived two winters from egg deposition) have a single freshwater annulus.

Adult returns (calculated by escapement method) and smolt production, by CWT and total populations, were calculated for each brood year where data was available. Smolt output and adult escapement were apportioned between brood years (back-calculated) using the age structure observed in the respective yearly migrations. The sum of freshwater age-2, age-3, and age-4 individuals equals total production for a given brood year. Age composition for smolts and adults by brood year were calculated based on the estimated production. Total survival by brood year was calculated as the age specific adult return divided by the respective smolt production. The smolt-to-spawner ratio for each brood year was calculated as the number of smolts produced divided by the number of adults in the escapement, by brood year. Similarly, the recruit-to-spawner ratio for each brood year was calculated as the number of adults produced divided by the number of adults in the escapement, by brood year.

Coded-wire Tag Recoveries

Coded-wire-tagged smolts were AFC prior to release. Coho smolts at Zolzap Creek were CWT in the spring of 1999 (Baxter and Stephens 2002) during out-migration.

Escapement: Crews examined all coho captured at the fence for the presence or absence of the adipose fin. The contribution and survival of AFC coho to the escapement was determined using methods presented in Bocking et al. (1992) and modified in Nass (1997a). CWT heads were collected from fish captured at the Nass River fishwheels, fish recovered in the native angling fishery below and above the fence, and from carcass recoveries.

Commercial and Sport Harvests: Commercial and sport catches of CWT fish are monitored by the Fisheries and Oceans Canada and various US agencies and compiled in the Mark Recovery Program (MRP) and in the ADF&G mark tag and age lab online searchable database. Data on CWT releases and recaptures are used to estimate the number of fish from a particular stock that have been harvested in the commercial and sport fishery, as well as determining the spatial and temporal distribution of harvests (Kuhn et al. 1988, Nass 1997a). The estimates include catch (observed catch corrected for sampling effort), expanded catch (estimated catch corrected for unmarked fish), exploitation rate (proportion of CWT coho caught in the fishery), and total return (expanded catch plus escapement).

Geographic Distribution of Harvest: Coded-wire-tagged fish in the commercial catch are recorded by Canadian and US fishery Statistical Areas. To estimate number of recoveries for each Canadian area, the observed CWT catch was expanded by the mean catch-sampling ratio observed in the Catch Region (e.g., Northern Troll = Stat Areas 1, 3, 4, and 6). Similarly, US troll catch was expanded using the catch sampling ratio by quadrant (e.g., northwest) and the net catch sampling ratios, by district.

RESULTS

Physical Observations

During the period that the adult fence was operational, water temperatures ranged from a maximum of 10 °C in early September to a minimum of 4 °C in mid November (Fig. 3B). Water level ranged from 0.3 m during base flows to 1.2 m during freshets (Fig. 3B).

Adult enumerations

The fence was operated continuously from 22 August to 15 November. A total of 412 adult coho salmon were counted at the fence including 3 coho released untagged (Table 6). Of these, 389 adults (adjusted for tag loss) were operculum tagged and released upstream. Maximum daily migration past the fence was 102 adults on 29 September (Table D-1) (Fig. 6).

Coho population assessments below the fence were conducted on 11, 14, 15, 16 October, and 1, 13 November. A total of 57 coho were captured using angling. All coho were sexed, opercular tagged and checked for AFC's. Of the 56 tagged coho released (1 escaped without a tag), none were recaptured below the fence during the surveys, and 25 (45%) were observed at the fence. Therefore, at least 31 coho remained below the fence.

For non-coho species captured at the fence, pink salmon had the greatest abundance (33), followed by Dolly Varden (27), and chum (24). Cutthroat (18), sockeye (5), and steelhead (4) were also captured at the fence (Table 3). Chum, pink, and sockeye were caught in their greatest numbers in mid-September. Cutthroat and Dolly Varden were mainly caught in mid-October. The number of chum and sockeye caught in 2000 were lower than in 1999 and below the 1992-1999 averages (40 and 13 respectively). The number of cutthroat and Dolly Varden also decreased from 1999 and steelhead showed a slight increase in number. No population estimates were derived for non-coho species.

Mark-recapture Estimates

Crews examined a total of 47 adult coho carcasses collected on the fence, and in ten upstream surveys. Surveys were conducted upstream of the fence from 4 October to 14 November at three access locations along the creek. Upstream surveys were conducted on 4, 6, 7, 8, 26, 31 October, and 2, 7 November at Goat Creek (a tributary); 8, 14 November at upper Zolzap Creek. Of the 47 adult coho examined, 40 were tagged, 7 were untagged and 2 had lost

their tags, which resulted in an estimate of 456 adults escaping to Zolzap Creek in 2000 (Table 6). An undetermined number of coho were observed spawning below the fence and an observation of coho above the fence after its demobilization on 15 November was also reported, so our estimate of 456 adult coho is likely underestimated.

Biosampling - Age and Length

A total of 308 coho were sampled for scales, of which 236 were successfully aged (Table 7). Unaged samples included marine regenerates. Adult males and females had different age compositions which averaged 53.6% and 44.4% freshwater age-2, 45.5% and 54.8% freshwater age-3, and 0.9% and 0.8% freshwater age-4 respectively. The total age composition was 48.7% age-2, 50.4% age-3, and 0.8% age-4. All aged scales were recorded as marine age 1 (i.e., having 1 marine annulus).

Mean lengths of adult males and females were 51.3 cm (n=188, SD=9.9) and 54.5 cm (n=217, SD=5.0), respectively. Adult male coho were widely distributed over the range of 23 to 79 cm with a mode of 53 cm (Fig. 7). Female coho had a mode of 57 cm with a range of 33 to 75 cm. For coho sexed during processing, adult females captured at the fence (n=217) were more abundant than males (n=188).

Coded-wire Tag Recoveries

Escapement: Crews examined 409 adult coho at the fence for fin clips of which 260 were AFC (63.6%; Table 8). An estimated 290 adipose clipped adult coho returned to Zolzap Creek in 2000. In addition, of the 57 coho examined below the fence, 23 (40%) were AFC. Of the 23 AFC coho tagged below the fence, 16 were observed at the fence. Therefore, at least 7 AFC coho remained below the fence. Smolt to spawner survival (i.e., includes natural and harvest mortality) for adult coho was estimated at 2.0%.

Twenty-nine (29) CWT heads were collected at Zolzap Creek. Of these recoveries, 15 were from the native angling fishery below the fence and 14 were from carcass recoveries. In addition, 6 coho with adipose clips were recovered at the Nass River fishwheels. All of the CWT recoveries from Zolzap Creek were from the 1999 release at Zolzap Creek (codes 18-43-12, 18-43-13). Of the 6 fishwheel CWT recoveries, 2 were from the 1999 release at Zolzap Creek (code 18-43-12), and 4 were No-Pin.

Commercial and Sport Harvests: Total observed Zolzap Creek coho CWT recoveries were 1 and 102 for Canadian and US (Alaska) fisheries, respectively (Table 9). Observed sport recoveries totalled 1 for the Canadian fisheries and 4 for the Alaskan fishery. All CWT recoveries were from the 1999 release year. US troll and net catch to sample ratios were 2.4 and 4.4, respectively (Table 9). Estimated Zolzap Creek CWT coho catches were 61 (19%) and 256 (81%) for Canadian and US fisheries, respectively, and the Nisga'a food fishery at Zolzap Creek harvested an observed 8 CWT coho (Table 9).

Expanded Canadian and US catches were 62 and 260, respectively, for a total of 322 using the CWT mark ratio at release (i.e., MRP method) (Table 10). Expanded Canadian and US catches were 96 and 402, respectively, for a total of 499 using the adipose-clip ratio at recovery (i.e., escapement method). Estimated total adult return for Zolzap Creek coho was 617 and 955 using the MRP and escapement methods, respectively (Table 10).

Of the total commercial catch of Zolzap Creek coho, Canadian fisheries accounted for 0% and the US accounted for 100% of the total commercial catch of Zolzap Creek coho (Table 11). US troll and net fisheries accounted for 92.7% and 7.3% of the total US catch, respectively. Commercial harvest of Zolzap Creek coho occurred over a wide area ranging from SE Alaska to the US Northern Outside Statistical Area in Alaska (Fig. 8). Due to restricted fisheries, no Canadian harvests were reported and no CWT returns were received from the Canadian fishery. US harvests were largest in the Southern Inside Statistical Area for the net fishery (6.1%) and the Central Outside Statistical Area for the troll fishery (51.4%; Table 11).

Total exploitation rate (Canadian and US combined) on Zolzap Creek coho in 2000 was 52.0% (Table 12). Total Canadian exploitation rate was 11.1% and total US exploitation rate was 40.9% (35.6% troll, 2.7% net, 2.6% sport). Total survival based on CWT returns was 4.3% (Table 12).

DISCUSSION

Over the past nine years of monitoring, the average number of smolts estimated leaving Zolzap Creek was 29,833 (Table 12). For the same time period, the average age composition of the smolt population was 61.1% age-2, 37.8% age-3, and 1.1% age-4 (Table 13).

Adult coho enumerated at the fence in 2000 (409) accounted for 89.5% of the Peterson population estimate (456). Therefore, approximately 47 adults entered Zolzap Creek during the period in which the fence was not operational. An undetermined number of coho were observed spawning below the fence and an observation of coho above the fence after its demobilization on 15 November was also reported. The native fishery harvested 14 coho below the fence of which 8 were CWT. Average escapement estimates for 1992 - 2000 was 1,102 (Table 12).

Data from 1992 to1999 have indicated that there are no jacks in the Zolzap Creek escapement (Nass 1996b, 1996c, 1997a, 1997b, 2001, Nass and Frith 2001, Baxter et al. 2001, Baxter and Stephens 2002). In 2000, CWT and scale ageing data have confirmed again the absence of jacks in the population. There were 29 heads taken at Zolzap Creek for CWT sampling from coho measured between 32 and 72 cm (post-orbital-hypural) and all were found to be from 1999 releases. Only 2 of the samples recovered were from coho measuring less than 35 cm. This length has been used in previous studies at other BC streams to designate jacks in the escapement and is based on CWT analysis. Both the CWT analysis and scale ageing show that coho less than 35 cm from Zolzap Creek in 2000 were marine age-1.

The Department of Fisheries and Oceans, Canada, operates a juvenile and adult fence site at Lachmach River, BC which is used as a Northern BC wild coho indicator stock. Exploitation rates for Lachmach coho have ranged from 21.8% to 70% for the 1994-2000 period (Holtby et al

1999, Barry Finnegan, PBS, Nanaimo, pers. comm.). These exploitation rates are very similar to Zolzap exploitation rates for the same time period (Fig. 9). Total survival for Lachmach coho has ranged from 5.5% (1997) to 17.4% (1994) and has been consistently higher than Zolzap Creek survivals (Fig. 10).

In Alaska, comprehensive information exists for several southeast stocks, including Hugh Smith Lake (Southern Inside Statistical Area, see Fig. 8), which has been monitored since 1982. Preliminary data for the 2000 return suggests exploitation rates of 0% Canadian and 54.3% US (54.3% total; Leon Shaul, Alaska Dept. of Fish and Game, Douglas, AK, pers. comm.). Southeast Alaska and Canadian fisheries accounted for approximately 100% and 0% of the commercial catch of Hugh Smith coho, respectively. The total exploitation rate on Hugh Smith coho (54.3%) was very similar to exploitation rates on Zolzap Creek coho (52.0%) in 2000. This is the first year that exploitation rates at Zolzap have matched so closely with Hugh Smith exploitation rates and may be due to no Canadian directed fisheries on either stock. Preliminary CWT data for the 2000 return of Hugh Smith coho suggest a survival rate of 6.6% which is higher than for Zolzap Creek coho at 4.4%. Hugh Smith coho have had substantially higher survivals (1999: 14.0%, 1998: 11.4%, 1997: 8.2%, 1996: 17.9%, 1995: 13.7%, 1994: 19.4%, 1993: 13.0%) compared to Zolzap coho (1999: 7.0%, 1998: 3.1%, 1997: 2.4%, 1996: 6.6%, 1995: 3.6%, 1994: 8.9%, 1993: 2.1%) in the past six years.

Zolzap Creek CWT coho have been subjected to total exploitation rates between 46.0% and 72.3% and have had smolt-adult survival rates between 2.1% and 8.9% over the period 1993 to 2000 (Table 12, Figs. 9, 10). Canadian fisheries have had exploitation rates between 0% and 21.4% on Zolzap CWT coho, while US fisheries ranged between 39.2% and 54.8% (Fig. 11). Of the total catch of Zolzap Creek coho, Canadian fisheries have averaged 18.2% and the US has averaged 81.8%, over eight years (Table 12).

Total smolt production by brood year averaged 30,493 (1990 - 1995) and was composed primarily of freshwater age-2 fish (62.2%; Table 13). Adult production by brood year averaged 3,574 (1990 - 1995) and was 52.5% age-2 fish. Age composition at return was substantially different from that observed in the respective smolt populations and varied widely. Freshwater age-4 fish were absent from all adult escapements with the exception of the 1995 brood year. Total smolt-adult survival by brood year of all Zolzap coho (unmarked + CWT) averaged 11.9% (1990-1995; Table 13). Total smolt-adult survival of Zolzap CWT coho was substantially lower at 4.4%. Higher survival for all coho compared to CWT coho is likely due to a significant number of unmarked smolts leaving Zolzap during non-operational periods (Nass 1996c). The effects of these conditions are evident from the historical data which shows the AFC at release has been roughly three times that of the AFC rate at return for the period 1993-2000 at Zolzap Creek (Table 8). Therefore, by using only CWT fish, the uncertainty around the number of fish released is eliminated and produces a more accurate estimate of survival for Zolzap coho smolts.

Estimates of total survival and exploitation are based on the assumption that all CWT coho are recovered in fisheries or on the spawning grounds. At Zolzap Creek, it is possible that the escapement of AFC coho is underestimated due to straying. Coho are known to spawn downstream of Zolzap Creek in Zolzap Slough (a side channel to the Nass River) where some CWT coho may return. In addition, a total of six adipose clipped coho were recovered in the

fishwheels above Zolzap Creek in 2000 (2 were from the 1999 release at Zolzap Creek, 4 were No-Pin) which tends to confirm our theory of straying. Straying would affect Zolzap Creek survival and exploitation estimates by underestimating survival and overestimating exploitation rates.

Zolzap Creek coho survivals may also be lower than Lachmach and Hugh Smith coho due to predator/prey interactions, with Zolzap Creek coho being more vulnerable to predation during their outmigration. Hugh Smith and Lachmach are both coastal systems and empty directly into marine waters, whereas Zolzap Creek empties into the Nass River. Zolzap Creek smolts must migrate approximately 33 km through Riverine habitat until they reach the ocean and are therefore more susceptible to predation along the way.

Persistent low water conditions at Zolzap Creek in the fall, result in coho holding below the fence in Zolzap Slough until water levels rise. During certain low water years this may result in coho spawning in the Slough area or pulsing through after the fence is demobilized. During these times, the run timing of the returning adult coho may be more an artifact of water levels rather than natural run timing. It is recommended that during subsequent years, the fence be run longer into the fall and increased effort be apportioned to upstream surveys to ensure a complete census of returning coho. A combination of video counting and resistivity counters could also be used in conjunction with a manned weir operation during the later fall period so as not to hold up the natural coho escapement.

The number of smolts per spawner was 17.0 for the 1996 brood year. This value is conservative as the number of smolts released was likely underestimated. The number of recruits per spawner was 2.3 for the 1996 brood year (Table 13).

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REFERENCES

Baxter, B.E, and C. Y. Stephens. 2002. Adult and Juvenile coho salmon enumeration and coded-wire tag recovery analysis for Zolzap Creek, BC, 1999. Can. Manuscr. Rep. Fish. Aquat. Sci. 2597: viii + 46 p.

Baxter, B.E, C. Y. Stephens and B. L. Nass.. 2001. Adult and Juvenile coho salmon enumeration and coded-wire tag recovery analysis for Zolzap Creek, BC, 1998. Can. Manuscr. Rep. Fish. Aquat. Sci. 2566: viii + 44 p.

Bocking, R.C., R.E. Bailey, and J.R. Irvine. 1992. Coho salmon (*Oncorhynchus kisutch*) escapement studies in Black Creek, French Creek, and Trent River, Vancouver Island, 1989. Can. Man. Rep. Fish. Aquat. Sci. 2160: 77p.

Conlin, K. and B.D. Tutty. 1979. Juvenile salmonid field trapping manual. Fish. Mar. Serv. Manusc. Rep. 1530: 136 p.

Holtby, L. B., B. O. Finnegan, D. Chen, and D. Peacock. 1999. Biological assessment of Skeena River coho salmon. PSARC Working Paper S99-12:113p.

Kuhn, B.R., L. Lapi, and J.M. Hamer. 1988. An introduction to the Canadian database on marked Pacific salmonids. Can. Tech. Rep. Fish. Aquat. Sci. 1649: viii + 56p.

Nass, B.L. 2001. Adult and Juvenile coho salmon enumeration and coded-wire tag recovery analysis for Zolzap Creek, BC, 1996. Can. Manuscr. Rep. Fish. Aquat. Sci. 2564: viii + 44 p.

Nass, B.L. and H.R. Frith. 2001. Adult and juvenile coho salmon enumeration and coded-wire tag recovery analysis for Zolzap Creek, BC, 1997. Can. Manuscr. Rep. Fish. Aquat. Sci. 2565: viii + 41 p.

Nass, B.L. 1997a. Adult and Juvenile coho salmon enumeration and coded-wire tag recovery analysis for Zolzap Creek, BC, 1994. Can. Manuscr. Rep. Fish. Aquat. Sci. 2420: viii + 54 p.

Nass, B.L. 1997b. Adult and Juvenile coho salmon enumeration and coded-wire tag recovery analysis for Zolzap Creek, BC, 1995. Can. Manuscr. Rep. Fish. Aquat. Sci. 2423: viii + 54 p.

Nass, B.L. 1996a. Enumeration and coded-wire tagging of coho salmon smolts at Zolzap Creek, and enumeration of coho salmon smolts at Seaskinnish and Ginlulak Creeks, 1992. Can. Manuscr. Rep. Fish. Aquat. Sci. 2376: viii + 44 p.

Nass, B.L. 1996b. Escapement enumeration studies of adult coho salmon at Zolzap Creek, BC, 1992. Can. Manuscr. Rep. Fish. Aquat. Sci. 2374: viii + 30 p.

REFERENCES

Nass, B.L. 1996c. Escapement enumeration studies of adult coho salmon at Zolzap Creek, BC, 1993. Can. Manuscr. Rep. Fish. Aquat. Sci. 2373: viii. + 35 p.

Nass, B.L. and K.K. English. 1994. Enumeration and coded-wire tagging of coho salmon smolts at Zolzap Creek, 1993. Report NF 93-01 prepared by LGL Limited, Sidney, BC for Nisga'a Tribal Council, New Aiyansh, BC.

Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Bull. Fish. Res. Bd. Can. 191. 382 p.

TABLES

Table 1. Age - length distribution of Zolzap Creek coho smolts, 2000.

Size-Class (mm)	Age Sample (X)	Age-groups in X 2	3	Length Sample (Y)	Calculated Age Representation in Y 2	3
70	1	1	0	3	3.0	0.0
75	0	0	0	4	4.0	0.0
80	15	15	0	26	26.0	0.0
85	42	42	0	87	87.0	0.0
90	59	58	1	150	147.5	2.5
95	54	54	0	160	160.0	0.0
100	52	52	0	151	151.0	0.0
105	50	49	1	111	108.8	2.2
110	62	59	3	132	125.6	6.4
115	56	52	4	132	122.6	9.4
120	42	37	5	98	86.3	11.7
125	18	17	1	47	44.4	2.6
130	13	10	3	31	23.8	7.2
135	5	2	3	10	4.0	6.0
140	2	0	2	3	0.0	3.0
145	0	0	0	0	0.0	0.0
150	0	0	0	0	0.0	0.0
155	0	0	0	0	0.0	0.0
160	0	0	0	0	0.0	0.0
165	0	0	0	0	0.0	0.0
170	0	0	0	0	0.0	0.0
175	0	0	0	0	0.0	0.0
180	0	0	0	0	0.0	0.0
Mean length				105.3	104.6	121.8
SD				13.0	12.5	11.7
Mean weight (g)				11.7	11.4	17.9
SD				4.4	4.2	5.3
Total samples	471	448	23	1,145	1,094	51
% contribution		95.1	4.9		95.5	4.5

Table 2. Coho smolt catch at Zolzap Creek enumeration fence, by week, in 2000.

Week ending	Catch
29-Apr	9
6-May	890
13-May	4,472
20-May	7,181
27-May	10,724
3-Jun	7,437
10-Jun	2,024
17-Jun	1,094
24-Jun	103
Total	33,934

Table 3. Non-coho catch at the spring juvenile and fall adult fences at Zolzap Creek, 1992-2000[a].

Species	Time/lifestage	1992	1993	1994	1995	1996	1997	1998	1999	2000	Avg.
Pink	Fall Adult	115	149	251	52	72	44	23	71	33	90
Chum	Spring Juvenile						344	549	79	5	244
	Fall Adult	30	111	68	8	19	42	24	32	24	40
Sockeye	Spring Juvenile	4	244	328	189	119	0	798	231	98	223
	Fall Adult	4	11	28	7	0	39	10	11	5	13
Cutthroat	Spring Juvenile	12	69	36	67	121	42	268	141	259	113
	Spring Adult	308	278	224	43	55	2	117	30	13	119
	Fall Adult	17	27	14	28	18	12	14	28	18	20
Dolly Varden	Spring Juvenile	682	309	339	518	711	337	732	647	1,095	597
	Spring Adult	644	728	1,529	28	44	7	25	5	11	336
	Fall Adult	9	21	10	81	39	21	30	174	27	46
Steelhead	Spring Juvenile	11	15	36	12	30	4	82	33	41	29
	Spring Adult	33	0	5	0	0	0	0	0	0	4
	Fall Adult	5	0	2	0	0	0	4	1	4	2
Lamprey[b]	Spring Juvenile	749	906	1,277	2,314	1,333	1,794	2,264	1,806	539	1,442
	Spring Adult	-	-	-	-	28	97	144	199	177	129
	Fall Adult	-	-	-	2	16	4	1	0	0	4

[a] Trapping effort not equal between years.

[b] Adults and juveniles not distingushed for period 1992 - 1995.

Table 4. Coded-wire tag retention rates for Zolzap Creek coho smolts, 2000.

Sampling Date	Tagging Date	Tag code	Hours held	Sample size	No. fish no tag	Percent retention
7-May	4-May	28-01-04	72	200	1	99.5
9-May	7-May	28-01-04	48	200	0	100
11-May	9-May	28-01-04	48	200	1	99.5
12-May	11-May	28-01-04	24	200	2	99
13-May	12-May	28-01-04	24	200	0	100
14-May	13-May	28-01-04	24	200	0	100
15-May	14-May	28-01-04	24	200	0	100
16-May	15-May	28-01-04	24	200	0	100
17-May	16-May	28-01-04	24	200	0	100
18-May	17-May	28-01-04	24	200	0	100
20-May	19-May	28-01-04	24	200	2	99
Subtotal				2,200	6	99.7
21-May	20-May	28-01-05	24	200	17	91.5
22-May	21-May	28-01-05	24	200	0	100
23-May	22-May	28-01-05	24	200	0	100
24-May	23-May	28-01-05	24	200	0	100
25-May	24-May	28-01-05	24	200	0	100
26-May	25-May	28-01-05	24	200	1	99.5
27-May	26-May	28-01-05	24	200	0	100
28-May	27-May	28-01-05	24	200	0	100
Subtotal				1,600	30	98.1
29-May	28-May	28-16-19	24	200	0	100
30-May	29-May	28-16-19	24	200	0	100
31-May	30-May	28-16-19	24	200	0	100
1-Jun	31-May	28-16-19	24	200	2	99
5-Jun	3-Jun	28-16-19	48	200	0	100
Subtotal				1,000	2	99.8
Grand Total				4,800	38	99.2

Table 5. Coded-wire tagged coho smolt releases from Zolzap Creek, 2000.

Tag code	Tagging dates	No. AFC	Tag morts	No. released AFC	No. tagged [a]	No. AFC only [b]	No. released untagged [c]	Total release [d]	CWT mark rate [e]
28-01-04	4 May - 19 May	11,384	46	11,337	11,306	31	97	11,434	1.01
28-01-05	20 May - 27 May	11,140	23	11,116	10,991	125	605	11,721	1.07
28-16-19	28 May - 13 June	7,899	52	7,851	7,835	16	2,510	10,361	1.32
	Total	30,423	121	30,304	30,132	172	3,212	33,516	1.11

[a] No. tagged (corrected for tag loss) = No. released AFC - (No. released AFC * No. lost tags / No. sampled); see Table 4.

[b] No. AFC only = No. released AFC - No. tagged

[c] No. released untagged = the number of unmarked fish released which belong to the same group as the tagged and AFC only fish.

[d] Total release = No. tagged + AFC only + untagged

[e] CWT mark rate = Total release / No. tagged

Table 6. Fence enumerations, carcass recoveries, and Petersen population estimates for adult coho escapement above the counting fence at Zolzap Creek, 2000.

Item	Adults
Number live coho captured at fence[a]	409
Number of live coho released untagged	3
Number live coho operculum tagged	389 [b]
Number coho carcasses recovered	47
Number of coho carcasses recovered untagged	7
Number of coho carcasses recovered tagged	40
Petersen estimate	456
Upper 95% CL	616
Lower 95% CL	337

[a] Includes coho angled and tagged below fence that were passed upstream of the fence by hand
[b] Adjusted for tag loss.

Table 7. Freshwater age distribution of adult coho at Zolzap Creek, 2000.

Sex	Age 2		Age 3		Age 4		Total aged	Total unaged	Total sampled
	No.	%	No.	%	No.	%			
Adult males	59	53.6	50	45.5	1	0.9	110	33	143
Adult females	56	44.4	69	54.8	1	0.8	126	39	165
Total adults	115	48.7	119	50.4	2	0.9	236	72	308

Table 8. Estimates of total escapement of adipose clipped coho and contribution to escapement at Zolzap Creek, 1993-2000.

Year	No. examined (A)	No. with adipose clips (B)	% AFC (C=B/Ax100)	Population estimate (D)	% sampled (E=A/Dx100)	Estimated adipose clips (F=B/AxD)	No. smolts [a] AFC	No. smolts [a] unclipped	No. smolts [a] % AFC	Contribution to escap. [b]	Smolt to spawner (%) [c]
1993	784	191	24.4	1,048	74.8	255	33,923	6,678	83.6	306	0.8
1994	2,416	499	20.7	2,536	95.3	524	22,986	3,348	87.3	600	2.3
1995	906	308	34.0	908	99.8	309	29,615	4,804	86.0	359	1.0
1996	1,030	218	21.2	1,039	99.1	220	10,166	2,203	82.2	268	2.2
1997	462	201	43.5	470	98.3	204	20,625	1,265	94.2	206	0.9
1998	963	212	22.0	967	99.6	213	13,566	992	93.2	228	1.6
1999	1,294	451	34.9	1,393	92.9	486	13,950	1,771	88.7	547	3.5
2000	409	260	63.6	456	89.7	290	14,591	233	98.4	295	2.0
Avg.	1,033	293	33	1,102	94	313	19,928	2,662	89	351	1.8

[a] smolt releases of the previous migration year; an unknown number of additional unclipped releases were likely.

[b] marked contribution to escapement = estimated adipose clips * (clipped + unclipped) / clipped.

[c] % survival = estimated AFC + AFC below the fence / AFC smolts* 100.

Table 9. Estimated Canadian and American commercial and sport harvest of Zolzap Creek CWT coho in 2000 using tag recovery data (Mark Recovery Program, Fisheries and Oceans, Canada and ADF&G mark tag and age lab, online searchable database).

Tag	Observed CWT catch [a]				Catch-sample ratio [b]			Estimated CWT catch [c]			
code	N. Troll	N. Net	Sport	Total	N. Troll	N. Net	Sport	N. Troll	N. Net	Sport	Total
Canadian											
18-43-12	0	0	0	0	0.0	0.0	0.0	0	0	0	0
18-43-13	0	0	1	1	0.0	0.0	61.3	0	0	61	61
Total	0	0	1	1	0.0	0.0	61.3	0	0	61	61
American											
18-43-12	67	3	4	74	2.4	2.7	4.0	161	8	16	186
18-43-13	27	1	0	28	2.3	9.4	0.0	61	9	0	70
Total	94	4	4	102	2.4	4.4	4.0	222	17	16	256
Total	94	4	5	103	2.4	4.4	15.5	222	17	78	317
								Total commercial			240
								Total sport			78
								Total native fishery [d]			8
								Total escapement [e]			299
								Total CWT			624

[a] Observed CWT = CWT's recovered from the commercial and sport catch

[b] Cumulative catch-sample ratio = total coho catch / total coho sampled

[c] Estimated CWT = observed CWT catch * catch sampling ratio

[d] observed harvest

[e] Estimated CWT's (adipose clips corrected for tag loss at return) including those below the fence, and at the fishwheels; see Table 8

Table 10. Expanded Canadian and American commercial and sport harvest of Zolzap Creek coho and estimated total return, 2000.

Tag code	Total release	Smolts tagged [a]	Mark rate [b]	Expanded catch [c]									Contri-bution escap.	Total return [d]
				Canadian				American				Grand Total		
				Troll	Net	Sport	Total	Troll	Net	Sport	Total			
18-43-12	11,072	10,867	1.02	0	0	0	0	164	8	17	189	189		
18-43-13	3,752	3,705	1.01	0	0	62	62	62	10	0	71	133		
Total 1 [e]	14,824	14,572	1.02	0	0	62	62	226	18	17	260	322	295	617
Total 2 [f]			1.57	0	0	96	96	350	27	25	402	499	456	955

[a] Number smolts released with tags (corrected for tag loss), Nass and Frith (In Prep).

[b] Mark rate at release (= No. released / No. marked) for smolts and Total 1 (MRP method), and mark rate at return for total 2 (Escapement method).

[c] Expanded catch = EST * mark rate at release

[d] Total return = expanded catch + escapement

[e] Total 1 expanded catch is calculated using the total mark rate at release and the total estimated catch for all tag codes (Table 9).

[f] Total 2 expanded catch is calculated using the total adipose clip rate at recovery and the total estimated catch for all tag codes (Table 9).

Table 11. Estimated commercial harvest distribution of Zolzap Creek CWT coho by area and gear type, 2000. Percentage is of total commercial harvest (does not include sport recoveries).

Area [a]	Net	%	Troll	%	Total	%
Canada						
1	0	0.0	0	0.0	0	0.0
subtotal	0	0.0	0	0.0	0	0.0
U.S.A. (Alaska)						
Northern Outside	0	0.0	29	12.3	29	12.3
Central Outside	0	0.0	123	51.4	123	51.4
Southern Outside	3	1.2	30	12.4	33	13.6
Southern Inside	15	6.1	17	7.1	32	13.2
Central Inside	0	0.0	0	0.0	0	0.0
Southern Intermediate	0	0.0	23	9.6	23	9.6
Central Intermediate	0	0.0	0	0.0	0	0.0
subtotal	17	7.3	222	92.7	240	100.0
TOTAL	17	7.3	222	92.7	240	100.0

[a] includes respective sub-areas

Table 12. Adult and juvenile coho abundance and smolt-adult survival, by smolt year, at Zolzap Creek, 1992-2000.

Smolt Out-migration				Resulting Escapement			Total Return							Catch			Smolt-adult Surv. (%)	
Smolt Year	Count	Estimate A	CWT B	Return Year	Count	Estimate	Return Year	Expanded C	Estimated CWT D	% Esc	% Can	%US	%Can + US	Return Year	% Can	%US	Expanded C-A	Estimated CWT D-B
1992	40,601	53,000	33,150	1993	794	1,048	1993	2,832	690	37.0	15.5	47.5	63.0	1993	24.6	75.4	5.3	2.1
1993	26,334	51,000	22,649	1994	2,438	2,536	1994	9,645	2,025	27.7	18.6	53.7	72.3	1994	25.7	74.3	18.9	8.9
1994	34,419	41,000	29,319	1995	908	908	1995	3,057	1,069	32.3	12.9	54.8	67.7	1995	19.0	81.0	7.5	3.6
1995	12,369	13,000	10,156	1996	1,039	1,039	1996	3,159	674	39.5	21.4	39.2	60.5	1996	35.3	64.7	24.3	6.6
1996	20,745	23,000	20,519	1997	470	470	1997	1,072	486	45.8	8.8	45.4	54.2	1997	16.2	83.8	4.7	2.4
1997	15,099	18,000	13,566	1998	967	967	1998	1,986	400	54.0	0.0	46.0	46.0	1998	0.0	100.0	11.0	2.9
1998	15,937	19,000	13,900	1999	1,302	1,393	1999	2,808	980	50.5	1.2	48.3	49.5	1999	3.1	96.9	14.8	7.1
1999	15,153	16,000	14,572	2000	409	456	2000	955	623	48.0	11.1	40.9	52.0	2000	21.4	78.6	6.0	4.3
2000	33,934	34,500	30,132	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	23,843	29,833	20,885		1,041	1,102		3,189	868	41.9	11.2	47.0	58.2		18.2	81.8	11.6	4.7

Estimate A = Best estimate of total smolt outmigration based on fence counts and migration patterns.

CWT B = Number of smolts that were Coded-wire tagged during their outmigration.

Estimate C = Expanded catch using total adipose clip rate at recovery and the total estimated catch for all tag codes.

CWT D = Estimated catch and escapement of Zolzap Creek CWT coho by tag code, including commercial, sport, native, fishwheel recoveries.

Table 13. Adult and juvenile coho production by freshwater age class and brood year, Zolzap Creek, 1990-1997[a].

All fish

Brood Year	Smolt Production (by freshwater age)				Adult Return (by freshwater age)				Smolts (freshwater age)			Escapement (freshwater age)[c]			Smolt to Adult Survival (% by freshwater age)			
	Age 2	Age 3	Age 4	Total	Age 2	Age 3	Age 4	Total	% Age 2	%Age 3	%Age 4	% Age 2	%Age 3	%Age 4	Age 2	Age 3	Age 4	Overall
1990	28,779	16,371	287	45,437	1,651	3,819	0	5,470	63.3	36.0	0.6	30.2	69.8		5.7	23.3	0.0	12.0
1991	34,629	28,495	910	64,034	5,826	1,794	0	7,620	54.1	44.5	1.4	76.5	23.5		16.8	6.3	0.0	11.9
1992	12,218	4,927	161	17,306	1,263	1,478	0	2,741	70.6	28.5	0.9	46.1	53.9		10.3	30.0	0.0	15.8
1993	7,163	6,233	0	13,396	1,681	313	0	1,994	53.5	46.5	0.0	84.3	15.7		23.5	5.0	0.0	14.9
1994	16,606	6,282	228	23,116	759	1,348	0	2,107	71.8	27.2	1.0	36.0	64.0		4.6	21.5	0.0	9.1
1995	11,718	7,695	256	19,669	638	868	9	1,514	59.6	39.1	1.3	42.1	57.3	0.6	5.4	11.3	3.4	7.7
1996	11,077	6,624	0	17,701	1,940	481	-	2,422	62.6	37.4	0.0	80.1	19.9	-	17.5	7.3	0.0	13.7
1997[a]	9,088	1,553	-	10,641	465	-	-	465	85.4	14.6	-	100.0	-	-	5.1	-	-	4.4
Avg.[b]	18,519	11,667	307	30,493	1,969	1,604	1	3,574	62.2	37.0	0.9	52.5	47.4	0.6	11.1	16.2	0.6	11.9

CWT's

Brood Year	Smolt Production (by freshwater age)				Adult return (by freshwater age)				Smolts (freshwater age)			Escapement (freshwater age)[c]			Smolt to Adult Survival (% by freshwater age)			
	Age 2	Age 3	Age 4	Total	Age 2	Age 3	Age 4	Total	% Age 2	%Age 3	%Age 4	% Age 2	%Age 3	%Age 4	Age 2	Age 3	Age 4	Overall
1990	18,000	7,270	205	25,476	402	802	0	1,204	70.7	28.5	0.8	33.4	66.6		2.2	11.0	0.0	4.7
1991	15,379	20,377	711	36,466	1,223	628	0	1,851	42.2	55.9	1.9	66.1	33.9		8.0	3.1	0.0	5.1
1992	8,737	3,849	144	12,730	441	315	0	757	68.6	30.2	1.1	58.3	41.7		5.1	8.2	0.0	5.9
1993	5,596	5,561	0	11,157	359	142	0	500	50.2	49.8	0.0	71.6	28.4		6.4	2.6	0.0	4.5
1994	14,815	4,735	167	19,716	344	272	0	616	75.1	24.0	0.8	55.9	44.1	0.0	2.3	5.7	0.0	3.1
1995	8,831	5,630	233	14,694	128	303	6	437	60.1	38.3	1.6	29.4	69.3	1.3	1.5	5.4	2.4	3.0
1996	8,104	6,033	0	14,137	677	314	0	991	57.3	42.7	0.0	68.3	31.7	0.0	8.4	5.2	0.0	7.0
1997[a]	8,277	1,356	-	9,633	303	-	0	303	85.9	14.1	-	100.0	-	-	3.7	-	0.0	3.1
Avg.[b]	11,893	7,903	243	20,040	483	410	1	894	61.1	37.8	1.1	52.5	47.3	0.6	4.2	6.0	0.4	4.4

Brood Year	All fish		CWT's	
	smolts/spawner	recruits/spawner	smolts/spawner	recruits/spawner
1990				
1991				
1992	11.1	1.8	8.2	0.5
1993	12.8	1.9	10.6	0.5
1994	9.1	0.8	7.8	0.2
1995	21.7	1.7	16.2	0.5
1996	17.0	2.3	13.6	1.0
Avg.	14.3	1.7	11.3	0.5

[a] (-) Incomplete data for 1997, to be completed with data from subsequent returns.

[b] average for "Total" includes years for which complete production data is available.

[c] Age composition of adult escapement return for brood year.

FIGURES

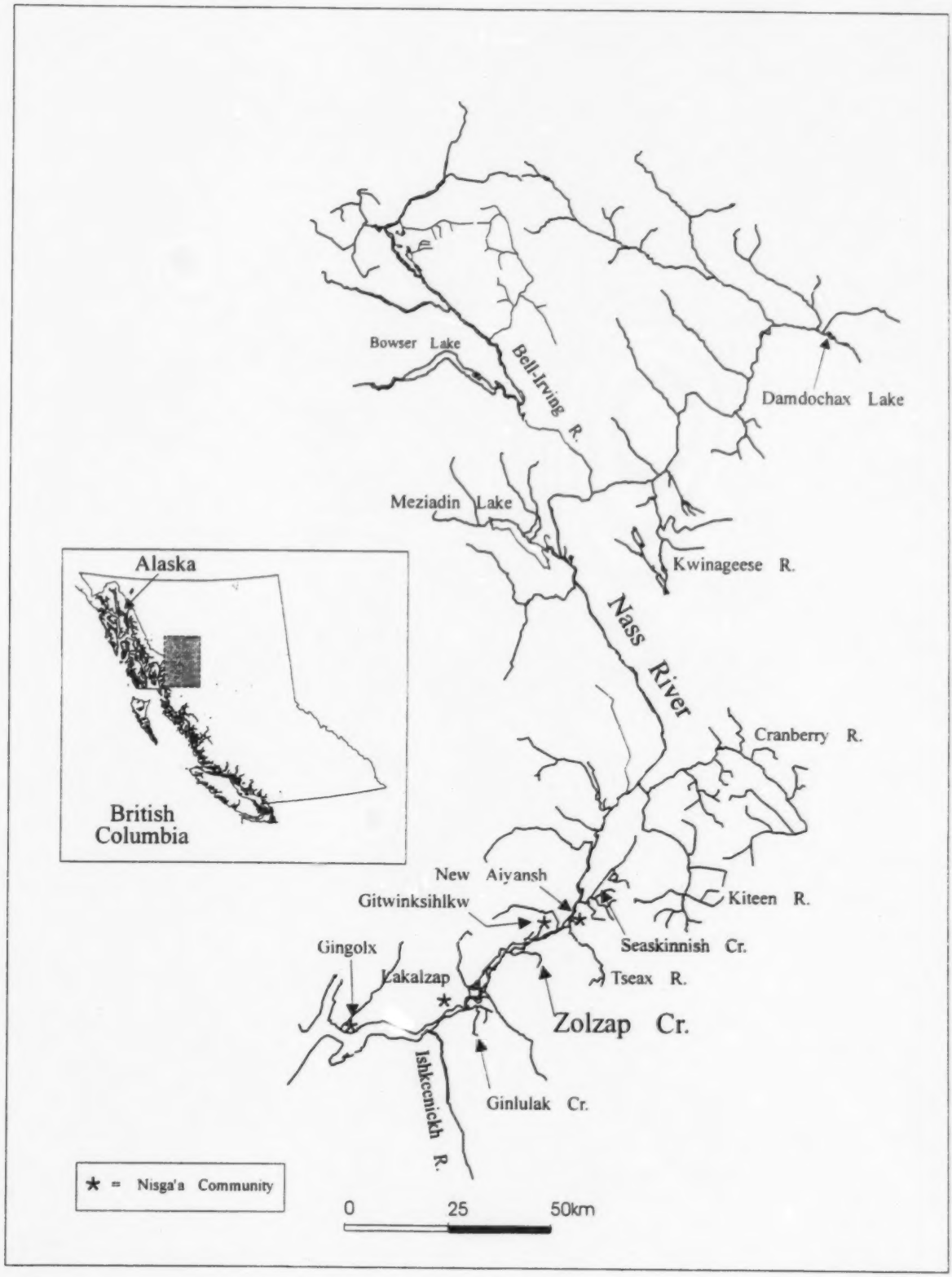

Figure 1. The Nass River watershed, British Columbia.

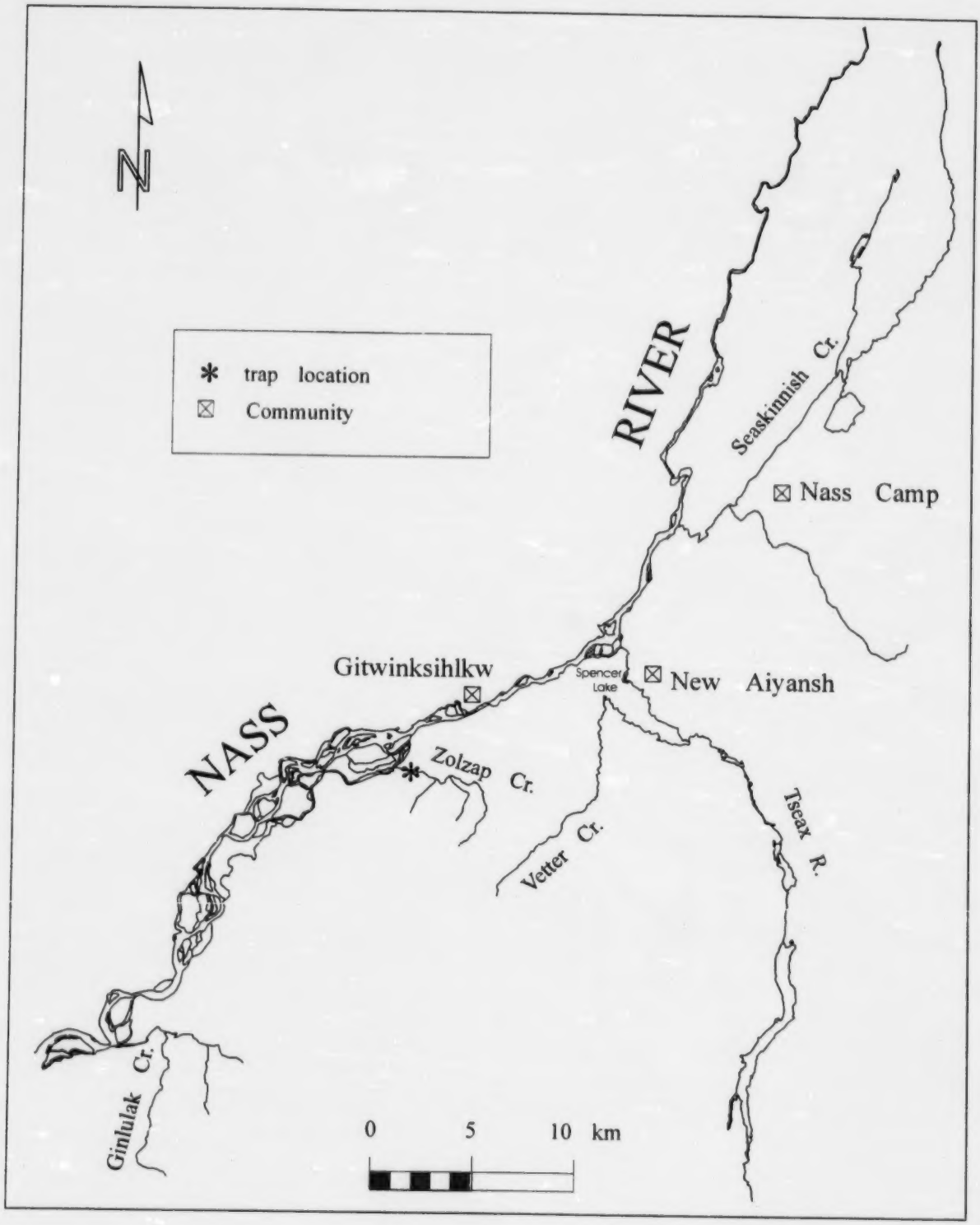

Figure 2. Zolzap Creek and location of enumeration fence.

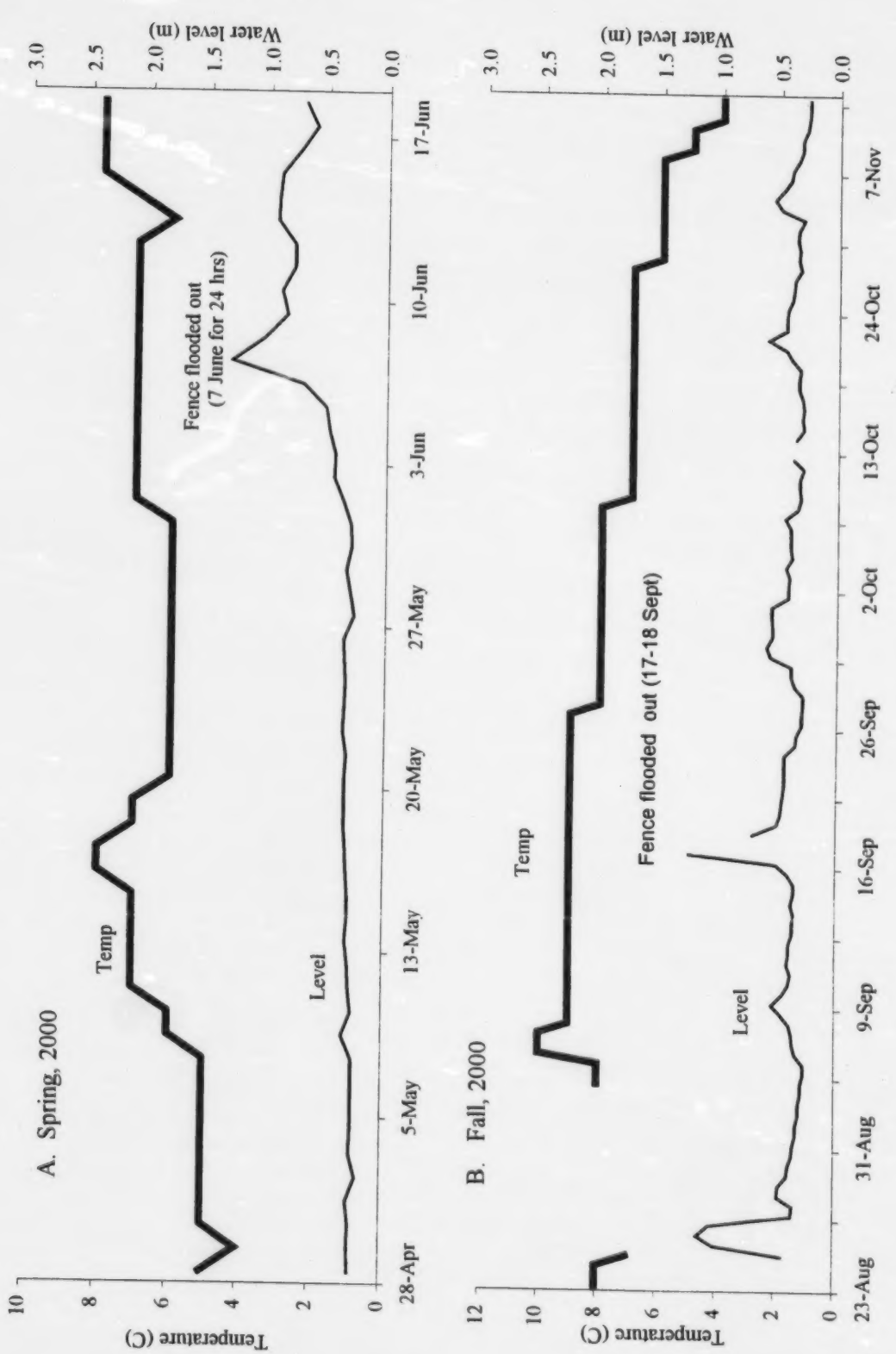

Figure 3. Water level and temperature at Zolzap Creek, 2000.

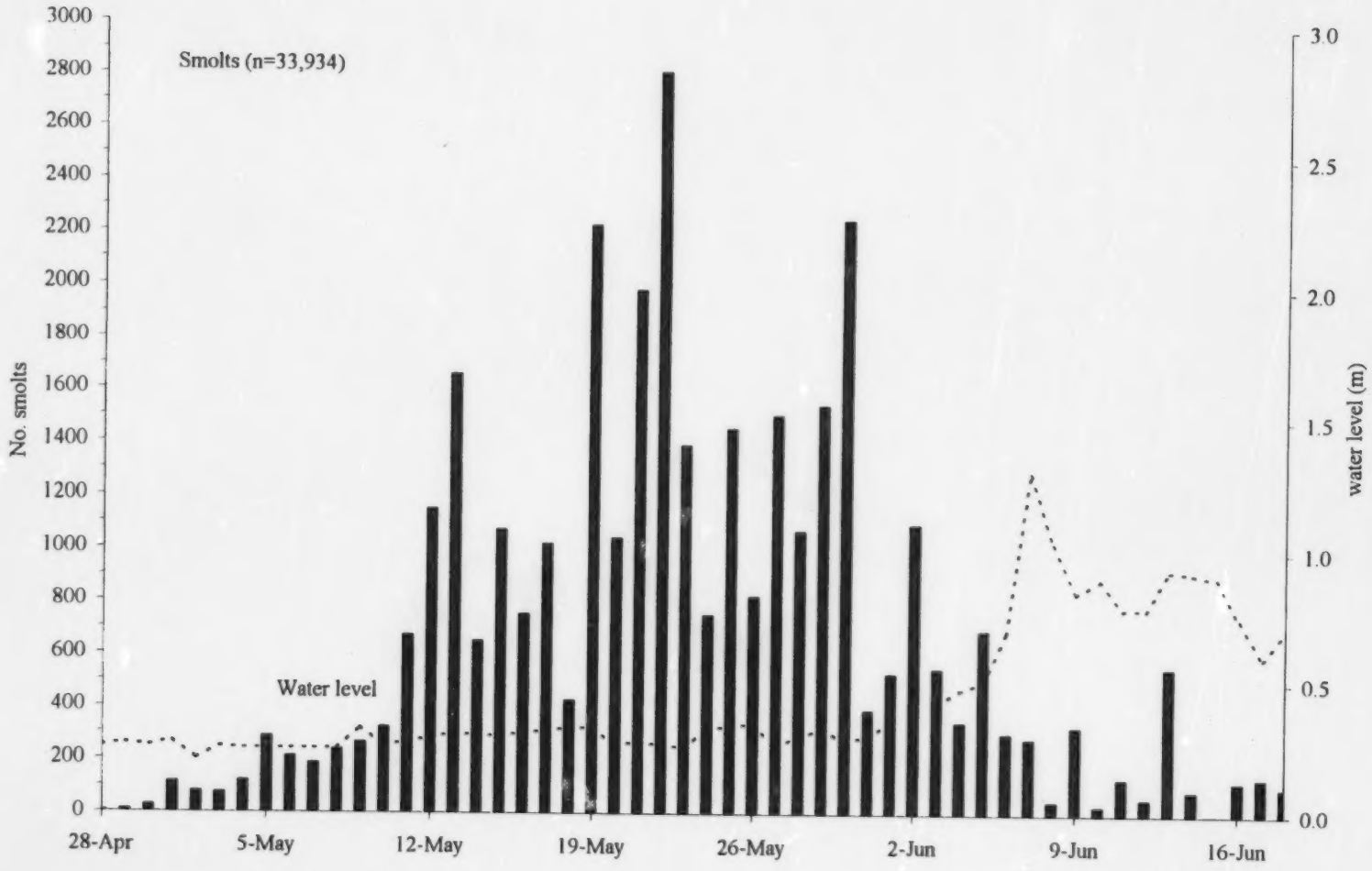

Figure 4. Daily migration of coho smolts at Zolzap Creek, 28 April - 18 June, 2000.

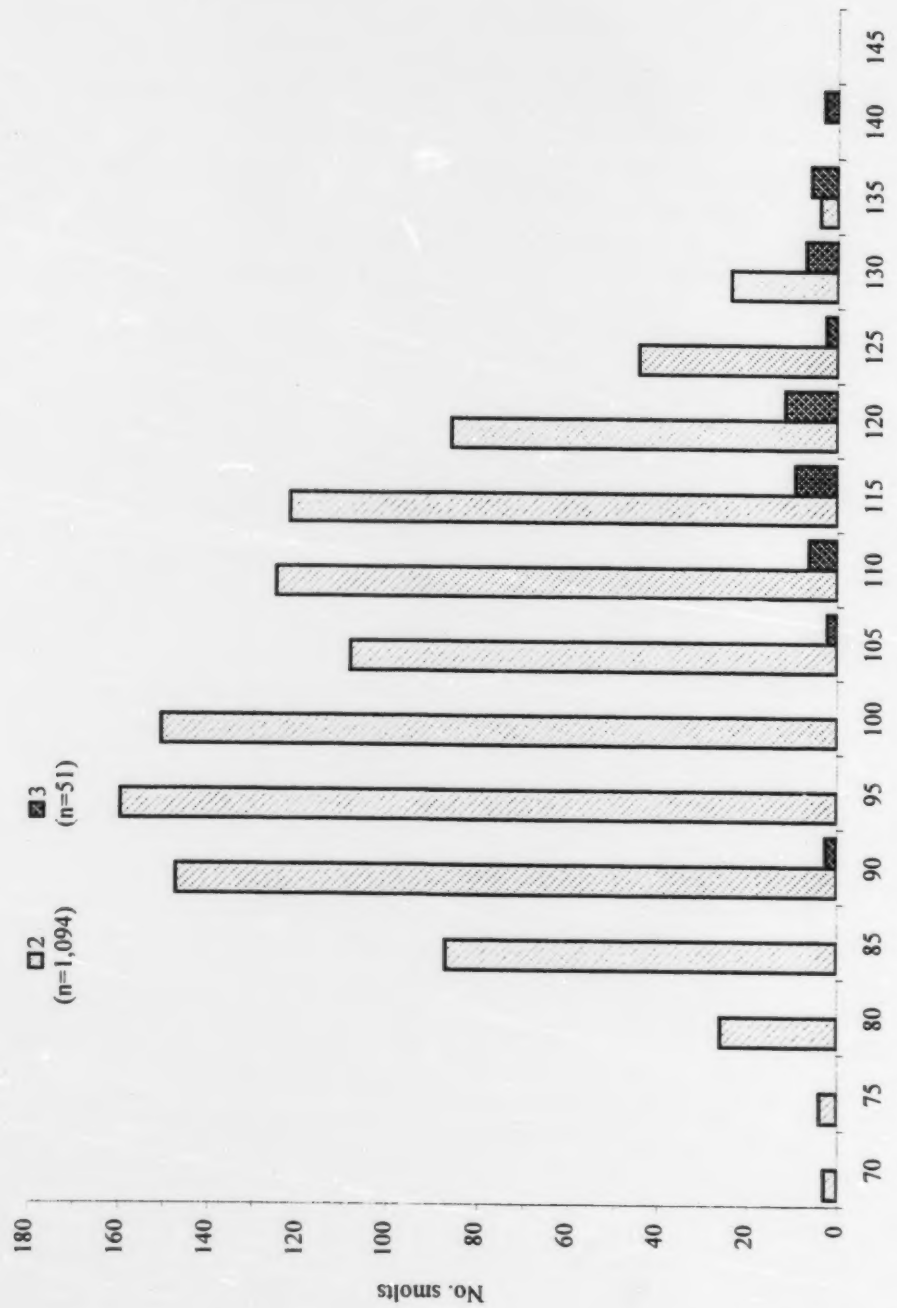

Figure 5. Length-frequency and calculated age distribution of Zolzap Creek coho smolts, 2000.

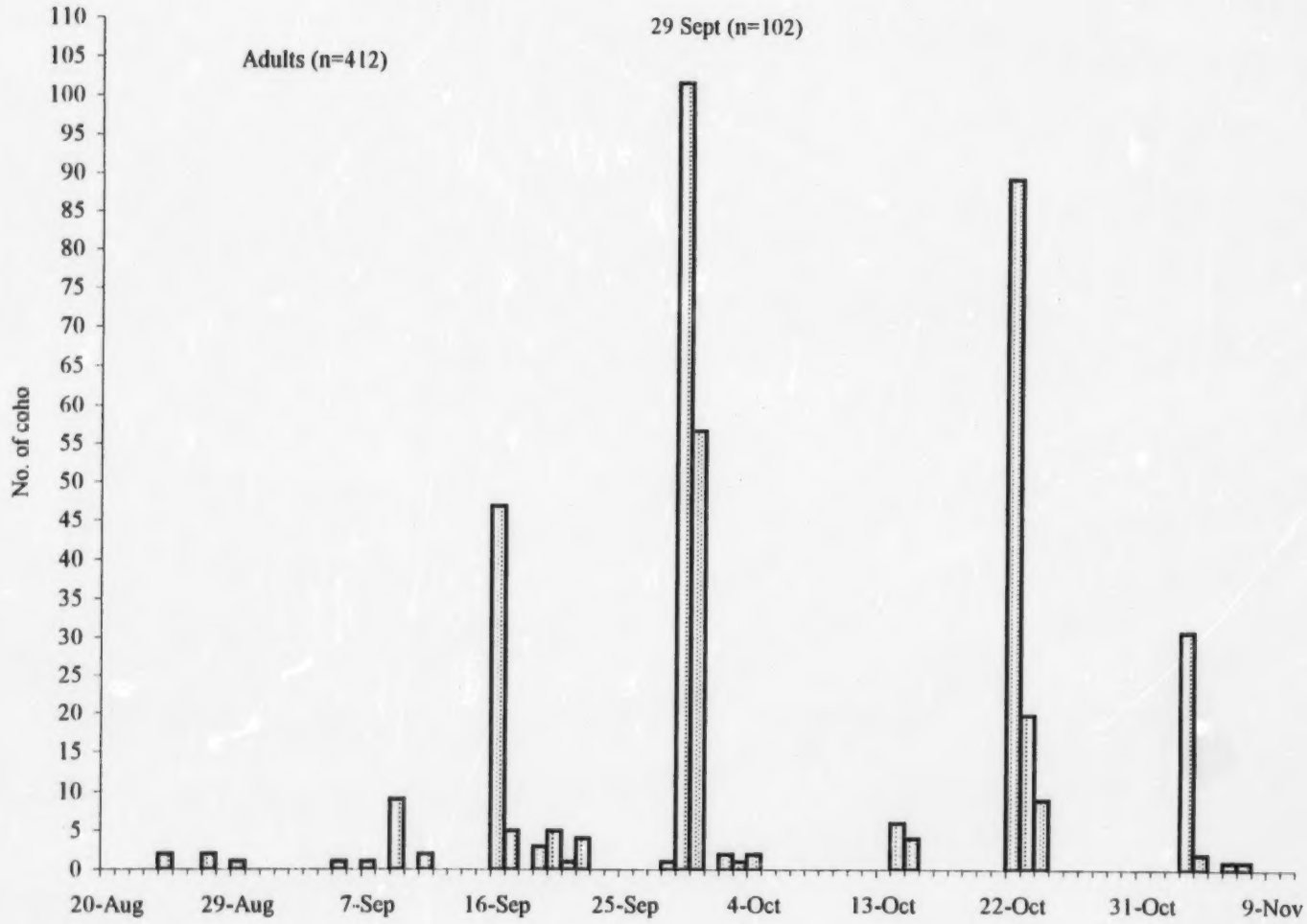

Figure 6. Daily counts of adult coho at the Zolzap Creek enumeration fence, 24 Aug - 7 Nov, 2000.

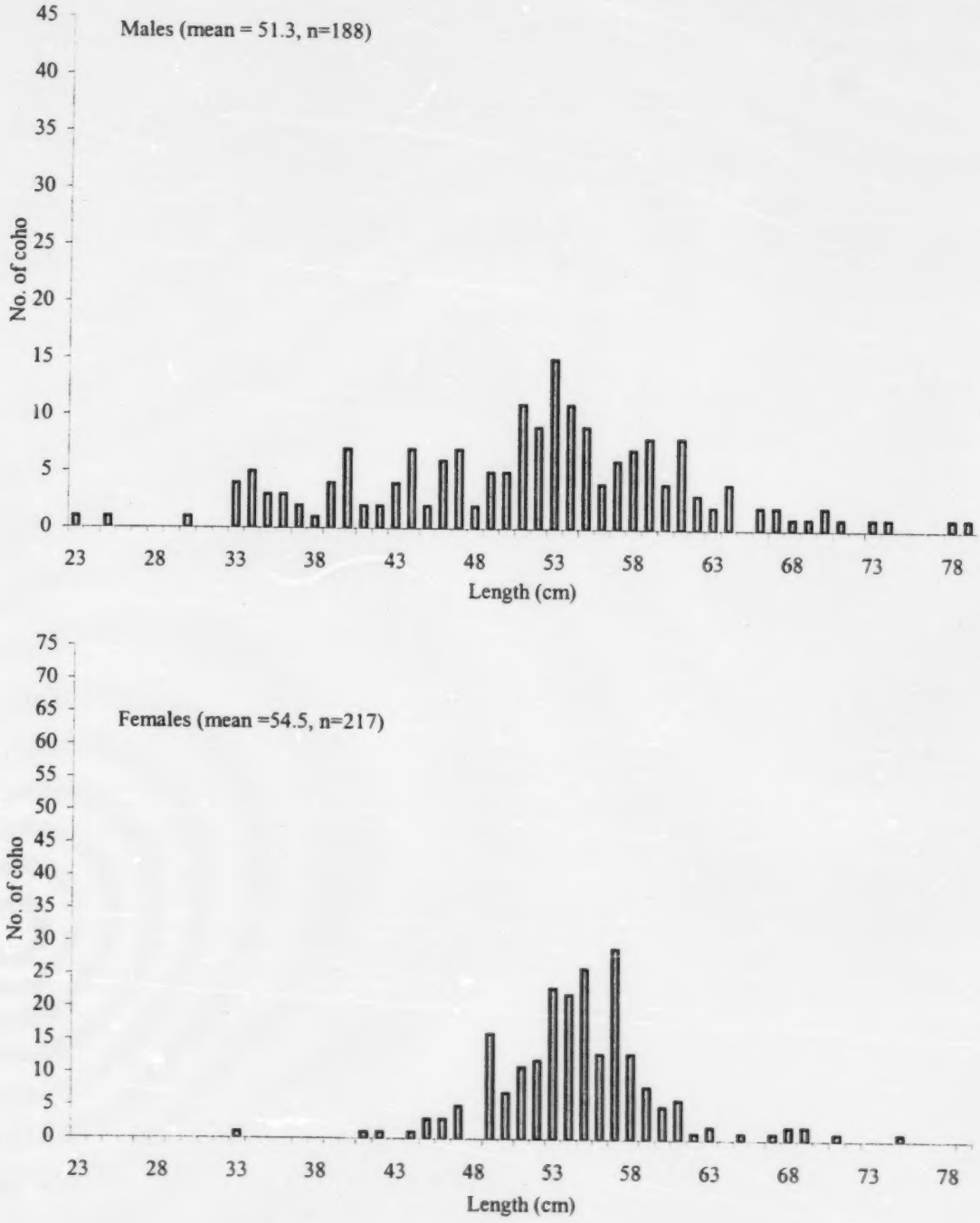

Figure 7. Length-frequency distribution of coho, by sex, Zolzap Creek, 2000.

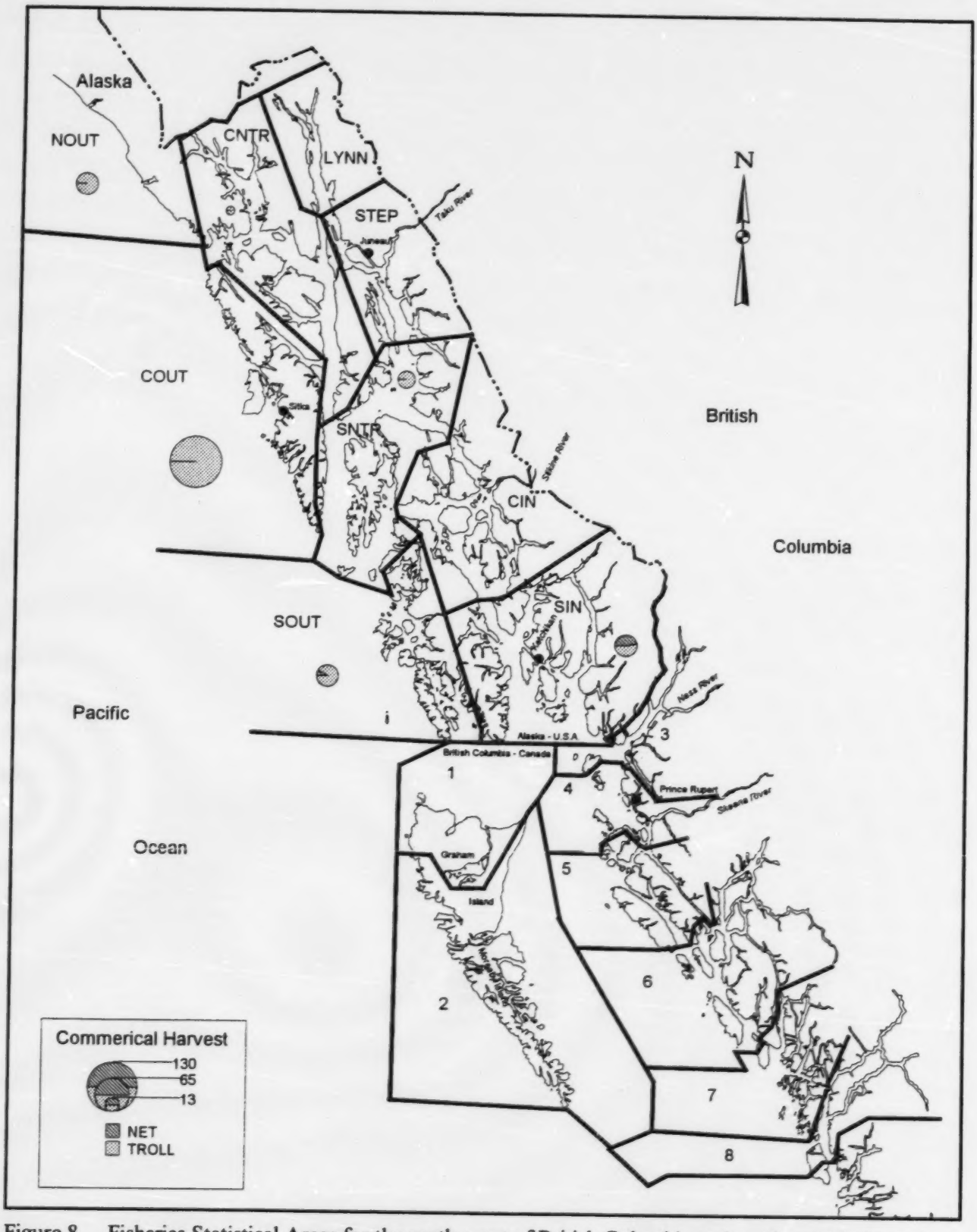

Figure 8. Fisheries Statistical Areas for the north coast of British Columbia and southeast Alaska, and commerical harvest distribution of Zolzap Creek CWT coho, 2000.

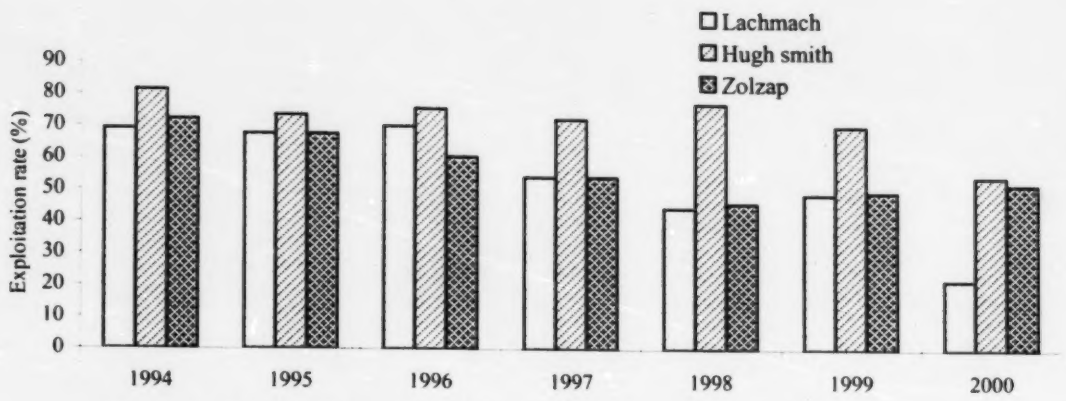

Figure 9. Exploitation rates for three wild coho indicator stocks.

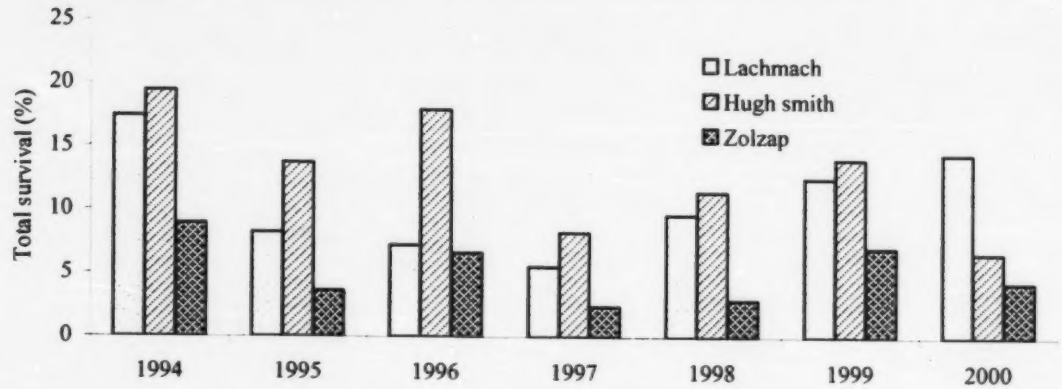

Figure 10. Total percent survivals for three wild coho indicator stocks.

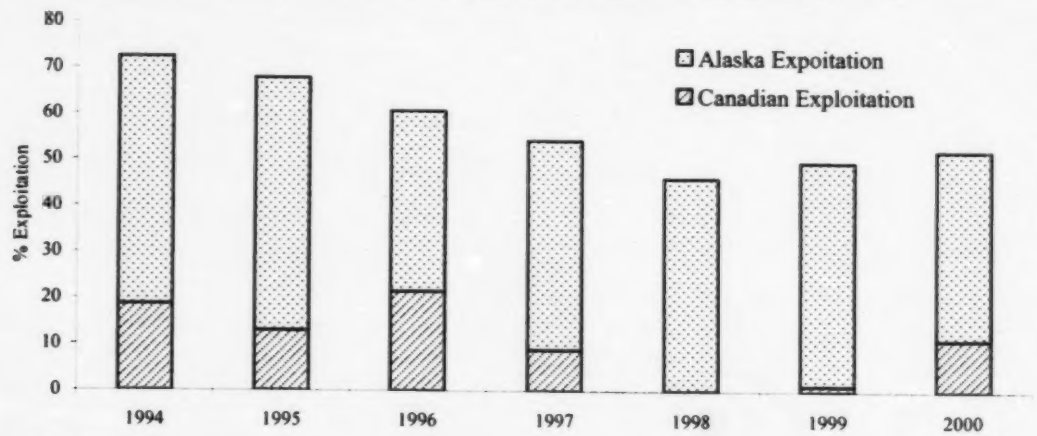

Figure 11. Canadian and Alaskan expoitation rates on Zolzap Creek coho, 1993-2000.

APPENDICES

Table A-1. Juvenile coho catch at Zolzap Creek enumeration fence, 2000.

Date	fry/presmolts	smolts	morts
28-Apr	0	3	0
29-Apr	0	6	0
30-Apr	0	25	0
1-May	0	111	0
2-May	0	76	0
3-May	1	71	0
4-May	1	118	2
5-May	4	282	0
6-May	1	207	0
7-May	2	184	0
8-May	1	234	0
9-May	7	261	0
10-May	0	318	0
11-May	4	668	0
12-May	0	1,151	0
13-May	1	1,656	0
14-May	1	649	0
15-May	1	1,072	2
16-May	0	748	0
17-May	0	1,019	0
18-May	0	422	0
19-May	1	2,227	0
20-May	1	1,044	0
21-May	1	1,983	0
22-May	2	2,813	0
23-May	0	1,391	0
24-May	0	750	0
25-May	0	1,457	0
26-May	1	821	0
27-May	0	1,509	0
28-May	0	1,074	0
29-May	0	1,547	0
30-May	0	2,256	0
31-May	0	388	0
1-Jun	0	526	0
2-Jun	0	1,098	0
3-Jun	2	548	0
4-Jun	2	344	0
5-Jun	4	694	0
6-Jun	0	300	0
7-Jun	10	281	0
8-Jun	3	47	0
9-Jun	1	328	3
10-Jun	5	30	0
11-Jun	1	134	0
12-Jun	4	57	0
13-Jun	6	553	0
14-Jun	6	89	0

Table A-1. Juvenile coho catch at Zolzap Creek enumeration fence, 2000.

Date	fry/presmolts	smolts	morts
15-Jun	0	0	0
16-Jun	0	123	0
17-Jun	3	138	0
18-Jun	4	103	0
Total	81	33,934	7

Table B-1. Non-coho catch at Zolzap Creek enumeration fence, 2000.

Date	Steelhead		Cutthroat		D. Varden		Sockeye	Chum			
	Juvenile	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile	Juvenile	Cottid	Lamprey	Stickleback
28-Apr	0	0	0	0	0	0	0	0	3	1	3
29-Apr	1	0	0	0	8	0	1	0	4	10	8
30-Apr	2	0	0	0	11	0	0	0	6	23	6
1-May	0	0	0	0	20	0	0	0	6	35	2
2-May	0	0	0	0	9	0	2	0	2	20	6
3-May	1	0	0	1	18	1	0	0	2	21	0
4-May	2	0	3	0	15	0	0	0	5	24	8
5-May	0	0	5	1	18	0	0	0	1	11	1
6-May	1	0	0	0	12	0	1	0	2	14	3
7-May	0	0	2	0	9	0	1	0	1	15	1
8-May	0	0	2	0	3	0	0	0	0	25	2
9-May	3	0	19	0	58	5	0	0	9	14	3
10-May	1	0	6	0	18	0	1	0	1	6	1
11-May	0	0	39	1	84	0	0	0	6	20	1
12-May	4	0	49	6	67	0	3	0	4	9	3
13-May	4	0	18	1	39	0	2	1	2	6	1
14-May	1	0	1	0	10	0	1	0	1	5	0
15-May	2	0	8	0	37	1	9	0	3	8	1
16-May	0	0	3	0	25	0	3	0	1	6	0
17-May	0	0	21	0	42	0	0	0	0	14	0
18-May	0	0	1	0	21	0	0	0	0	4	0
19-May	0	0	5	0	46	0	20	1	0	8	1
20-May	1	0	14	0	26	0	1	0	1	14	0
21-May	0	0	2	0	41	1	8	1	4	16	0
22-May	0	0	2	0	45	1	3	0	0	12	0
23-May	2	0	1	0	23	0	5	0	0	10	0
24-May	0	0	0	0	27	0	3	0	1	14	0
25-May	0	0	2	1	34	0	7	2	0	13	0
26-May	4	0	5	0	56	0	5	0	0	33	1
27-May	8	0	13	0	78	1	6	0	3	46	1
28-May	1	0	9	0	29	0	1	0	0	22	0
29-May	1	0	5	0	27	0	2	0	0	38	1

Table B-1. Non-coho catch at Zolzap Creek enumeration fence, 2000.

Date	Steelhead		Cutthroat		D. Varden		Sockeye	Chum			
	Juvenile	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile	Juvenile	Cottid	Lamprey	Stickleback
30-May	0	0	5	1	18	0	0	0	1	40	2
31-May	0	0	2	1	18	1	0	0	1	35	1
1-Jun	0	0	4	0	38	0	1	0	4	39	1
2-Jun	1	0	1	0	24	0	0	0	0	10	0
3-Jun	0	0	4	0	15	0	0	0	2	21	0
4-Jun	0	0	0	0	1	0	0	0	1	6	0
5-Jun	1	0	0	0	16	0	3	0	0	2	1
6-Jun	0	0	0	0	2	0	0	0	0	2	0
7-Jun	0	0	0	0	1	0	1	0	2	4	0
8-Jun	0	0	0	0	0	0	0	0	1	2	0
9-Jun	0	0	3	0	4	0	0	0	0	1	0
10-Jun	0	0	1	0	0	0	1	0	0	3	0
11-Jun	0	0	2	0	0	0	0	0	0	0	0
12-Jun	0	0	1	0	0	0	0	0	1	1	0
13-Jun	0	0	0	0	0	0	2	0	0	17	0
14-Jun	0	0	0	0	0	0	5	0	0	1	
15-Jun	0	0	0	0	0	0	0	0	0	0	0
16-Jun	0	0	0	0	1	0	0	0	1	5	2
17-Jun	0	0	0	0	1	0	0	0	0	6	0
18-Jun	0	0	1	0	0	0	0	0	0	4	1
Total	41	0	259	13	1,095	11	98	5	82	716	62

Table C-1. Coded-wire tagging data for coho smolts at Zolzap Creek, 2000.

Date	Total smolts	Fence morts	Tag code	No. AFC	Tag morts	No. rlsd. untagged	No. rlsd. AFC
28-Apr	3	0	0	0	0	3	0
29-Apr	6	0	0	0	0	6	0
30-Apr	25	0	0	0	0	25	0
1-May	111	0	0	0	0	0	0
2-May	76	0	0	0	0	0	0
3-May	71	0	0	0	0	0	0
4-May	118	0	28-01-04	371	4	3	367
5-May	282	0	0	0	0	0	0
6-May	207	0	0	0	0	0	0
7-May	184	0	28-01-04	669	4	3	665
8-May	234	0	0	0	0	0	0
9-May	261	5	28-01-04	493	6	2	487
10-May	318	1	0	0	0	0	0
11-May	668	1	28-01-04	982	5	2	977
12-May	1,151	0	28-01-04	1,147	4	2	1,143
13-May	1,656	2	28-01-04	1,643	5	9	1,638
14-May	649	0	28-01-04	647	2	1	645
15-May	1,072	1	28-01-04	1,067	3	4	1,064
16-May	748	0	28-01-04	744	4	0	739
17-May	1,019	3	28-01-04	1,013	6	0	1,007
18-May	422	0	28-01-04	33	0	0	33
19-May	2,227	12	28-01-04	2,575	3	37	2,572
20-May	1,044	0	28-01-05	1,030	2	12	1,028
21-May	1,983	9	28-01-05	1,955	3	18	1,952
22-May	2,813	2	28-01-05	2,780	3	30	2,777
23-May	1,391	2	28-01-05	1,380	3	8	1,377
24-May	750	0	28-01-05	744	4	6	739
25-May	1,457	1	28-01-05	1,439	3	16	1,436
26-May	821	0	28-01-05	809	2	12	807
27-May	1,509	3	28-01-05	1,003	3	503	1,000
28-May	1,074	2	28-16-19	1,000	3	72	997
29-May	1,547	0	28-16-19	1,014	3	533	1,011
30-May	2,256	0	28-16-19	1,022	3	1,234	1,019
31-May	388	0	28-16-19	383	4	1	380
1-Jun	526	0	28-16-19	512	4	14	512
2-Jun	1,098	0	28-16-19	1,009	2	89	1,007
3-Jun	548	30	28-16-19	489	22	29	467
4-Jun	344	12	0	0	0	0	0
5-Jun	694	1	28-16-19	990	3	35	987
6-Jun	300	1	0	0	0	3	0
7-Jun	281	8	28-16-19	551	3	18	548
8-Jun	47	0	0	0	0	0	0
9-Jun	328	12	0	0	0	0	0
10-Jun	30	0	28-16-19	394	3	11	391
11-Jun	134	0	0	0	0	0	0
12-Jun	57	0	0	0	0	0	0
13-Jun	553	0	28-16-19	535	2	18	532

Table C-1. Coded-wire tagging data for coho smolts at Zolzap Creek, 2000.

Date	Total smolts	Fence morts	Tag code	No. AFC	Tag morts	No. rlsd. untagged	No. rlsd. AFC
14-Jun	89	0	0	0	0	89	0
15-Jun	0	0	0	0	0	0	0
16-Jun	123	0	0	0	0	123	0
17-Jun	138	0	0	0	0	138	0
18-Jun	103	0	0	0	0	103	0
Total	33,934	108	-	30,423	121	3,212	30,304

Table D-1. Daily counts of adult coho at Zolzap Creek enumeration fence, 2000.

Date	No. examined	No. operculum tagged
24-Aug	2	2
25-Aug	0	0
26-Aug	0	0
27-Aug	2	2
28-Aug	0	0
29-Aug	1	1
30-Aug	0	0
31-Aug	0	0
1-Sep	0	0
2-Sep	0	0
3-Sep	0	0
4-Sep	0	0
5-Sep	1	1
6-Sep	0	0
7-Sep	1	1
8-Sep	0	0
9-Sep	9	9
10-Sep	0	0
11-Sep	2	2
12-Sep	0	0
13-Sep	0	0
14-Sep	0	0
15-Sep	0	0
16-Sep	47	47
17-Sep	5	5
18-Sep	0	0
19-Sep	3	3
20-Sep	5	5
21-Sep	1	1
22-Sep	4	4
23-Sep	0	0
24-Sep	0	0
25-Sep	0	0
26-Sep	0	0
27-Sep	0	0
28-Sep	1	1
29-Sep	102	101
30-Sep	57	55
1-Oct	0	0
2-Oct	2	2
3-Oct	1	1
4-Oct	2	2
5-Oct	0	0
6-Oct	0	0
7-Oct	0	0
8-Oct	0	0
9-Oct	0	0
10-Oct	0	0

Table D-1. Daily counts of adult coho at Zolzap Creek enumeration fence, 2000.

Date	No. examined	No. operculum tagged
11-Oct	0	0
12-Oct	0	0
13-Oct	0	0
14-Oct	6	6
15-Oct	4	4
16-Oct	0	0
17-Oct	0	0
18-Oct	0	0
19-Oct	0	0
20-Oct	0	0
21-Oct	0	0
22-Oct	90	90
23-Oct	20	20
24-Oct	9	9
25-Oct	0	0
26-Oct	0	0
27-Oct	0	0
28-Oct	0	0
29-Oct	0	0
30-Oct	0	0
31-Oct	0	0
1-Nov	0	0
2-Nov	0	0
3-Nov	31	31
4-Nov	2	2
5-Nov	0	0
6-Nov	1	1
7-Nov	1	1
Totals	412	409